THESIS/
REPORTS
SIEG, C.H.

Vegetation responses to fall and spring fire treatment—literature search and pre-burn data analysis

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FINAL REPORT

Cooperative Agreement No. 28-C6-391

Vegetation Response to Fall and Spring Fire Treatment--
Literature Search and Pre-burn Data Analysis

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30 March 1987

INTRODUCTION

The purpose of Cooperative Agreement No. 28-C6-391, between Texas Tech University and the Rocky Mountain Forest and Range Experiment Station (Research Work Unit No. 4252) was to provide a literature review, study plan, and summarization of pretreatment data for Study RC-900, "Regeneration of Bur Oak Woodlands in the Black Hills Using Prescribed Burning." The literature review and study plan were completed in December 1986. This report summarizes pretreatment shrub densities (on burn and unburned treatments), bur oak (*Quercus macrocarpa*) diameters (dbh), number of root sprouts, and ages (on burn treatments), plus aboveground biomass estimates for forbs and grasses, and litter biomass (on burn treatments).

SHRUB DENSITIES

Common snowberry (*Symphoricarpos albus*) was the most common shrub on the study area. Densities ranged from 11.2 to 17.7 stems/m^2 on the four burn treatments, and from 9.0 to 24.5 stems/m^2 on unburned treatments (Table 1). Snowberry densities ranged from 0 to 55.0 stems/1m^2 on Site 1 (Table 2), 0 to 76.7 stems/1m^2 on Site 2 (Table 3), 0 to 30.8 stems/1 m^2 on Site 3 (Table 4), and 0 to 49.2 on Site 4 (Table 5). Common chokecherry (*Prunus virginianus*) was the next most common shrub on the study area, ranging in density from 2.1 to 5.5 stems/m^2 on burn treatments, and 1.4 to 5.6 stems/m^2 on unburned treatments (Table 6). Chokecherry densities ranged from 0.3 to 14.7 stems/m^2 Site 1 (Table 7), 0 to 22.8 stems/m^2 on Site 2 (Table 8), 0 to 21.5 stems/m^2 on Site 3 (Table 9), and 0.1 to 3.9 stems/m^2 on Site 4 (Table 10). Poison ivy (*Toxicodendron rydbergii*) densities ranged from 0.01 to 3.1 stems/m^2 on burn treatments, and from 0.3 to 7.9 stems/m^2 on unburned treatments (Table 11). Densities of poison ivy ranged from 0 to 9.5 stems/m^2 on Site 1 (Table 12), 0 to 4.0 stems/m^2 on Site 2 (Table 13), 0 to 20.8 stems/m^2 on Site 3 (Table 14), and 0 to 19.6/m^2 on Site 4 (Table 15). Densities of rose (*Rosa spp.*) averaged less than 1 stem/m^2

on the four sites (Table 16), with a high of 2.6 stems/m^2 on Site 1 (Table 17), 0.7 stems/m^2 on Site 2 (Table 18), 2.4 stems/m^2 on Site 3 (Table 19), and 1.1 stems/m^2 on Site 4 (Table 20).

BUR OAK DATA

The average diameter breast height (dbh) of bur oak trees in the four (burn) sites ranged from 14.8 to 24.7 cm (Table 21). Each oak tree had an average of between 0.3 and 1.9 root sprouts, and the average age ranged from 41.2 to 80.4 years old (Table 21). Average diameters ranged from 8.1 to 22.2 cm on Site 1(Table 22), 4.4 to 40.4 on Site 2 (Table 23), 7.5 to 29.2 on Site 3 (Table 24), and 10.8 to 29.1 cm on Site 4 (Table 25). Average number of root sprouts ranged from 0 to 8 per tree on Site 1 (Table 22), 0 to 16 sprouts per tree on Site 2 (Table 23), 0 to 1.2 sprouts per tree on Site 3 (Table 24), and 0 to 2 spouts per tree on Site 4 (Table 25). The range of ages of bur oak trees averaged from 28 to 63 years old on Site 1 (Table 22), 16 to 113.5 years old on Site 2 (Table 23), 16 to 101 years old on Site 3 (Table 24), and 44 to 95 years old on Site 4 (Table 25). Approximately 30% of the bur oak trees suffered heart rot to some degree, which made exact determination of the ages difficult.

PLANT AND LITTER BIOMASS

Aboveground biomass (fine fuels) averaged between 331.9 and 892.3 kg/ha on the four sites; litter biomass ranged from 5,218.3 to 9594.7 kg/ha (Table 26). Fine fuel loads ranged from 305.0 to 2176.7 kg/ha on Site 1 (Table 27), 323.8 to 1352.5 kg/ha on Site 2 (Table 28), 78.8 to 1553.8 kg/ha on Site 3 (Table 29), and 6.3 to 1031.0 kg/ha on Site 4 (Table 30). Litter biomass ranged from 332.5 to 11,482.5 kg/ha on Site 1 (Table 27), 2,202.5 to 14,077.5 kg/ha on Site 2 (Table 28), 1,134 to 18,650 kg/ha on Site 3 (Table 29), and 930 to 23,405 kg/ha on Site 4 (Table 30).

Table 1. Average pretreatment densities (no./1 m^2) of common snowberry (*Symphoricarpos albus*) by site, in Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

	BURN		UNBURNED	
SITE	MEAN	± SD	MEAN	± SD
1	13.09	10.46	24.53	16.20
2	17.67	9.28	23.37	15.93
3	14.69	8.56	12.47	8.72
4	11.22	12.51	8.96	7.68

Table 2. Pretreatment densities (no./m2) of common snowberry (*Symphoricarpos albus*), by plot, on Site 1, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURN		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	39.17	46.99	21.67	22.50
2	5.83	10.84	40.83	38.25
3	0.00	0.00	7.50	16.03
4	9.17	10.84	35.83	22.75
5	20.00	30.15	0.00	0.00
6	1.67	3.89	1.67	3.89
7	4.17	7.93	30.83	16.21
8	5.00	10.00	5.00	6.74
9	2.50	6.22	16.67	15.57
10	26.67	22.29	45.00	33.44
11	16.67	25.35	30.83	26.10
12	23.33	21.46	30.83	23.14
13	18.33	17.49	28.83	19.46
14	6.67	7.79	37.50	28.64
15	13.33	10.73	30.00	23.36
16	13.33	14.97	10.83	11.65
17	22.50	19.13	20.00	24.12
18	0.00	0.00	1.67	3.89
19	14.17	14.43	42.50	26.67
20	13.33	19.23	55.00	25.05
21	6.67	14.97	10.00	20.89
22	10.83	10.84	40.00	32.75
23	6.67	6.51	5.83	9.96
24	34.17	21.09	40.00	45.53

Table 3. Pretreatment densities (no./1 m2) of common snowberry (*Symphoricarpos albus*), by plot, on Site 2, in Fort Meade Recreation Area, Sturgis, South Dakota.

PLOT	MEAN	± SD	MEAN	± SD
1	29.17	32.32	10.00	15.37
2	29.17	26.44	10.83	12.40
3	15.83	12.40	33.33	20.15
4	7.50	12.15	29.17	26.10
5	20.83	19.29	17.50	27.01
6	23.33	14.97	13.33	16.14
7	7.50	9.65	29.17	25.75
8	10.00	10.44	25.83	20.21
9	20.00	20.89	20.83	26.44
10	30.83	25.03	53.33	37.01
11	0.00	0.00	15.83	26.44
12	16.67	23.09	76.67	47.17
13	3.33	8.88	29.17	25.39
14	18.33	16.97	5.83	10.83
15	19.17	25.39	10.83	19.75
16	17.50	22.61	5.00	10.00
17	31.67	18.01	15.83	15.64
18	15.83	10.84	35.83	30.59
19	5.83	7.93	17.50	16.03
20	26.67	22.70	15.83	15.05
21	8.33	8.35	10.00	12.79
22	18.33	20.82	20.83	17.82
23	31.67	32.43	28.33	23.68
24	16.67	14.97	30.00	18.09

Table 4. Pretreatment densities (no./1 m2) of common snowberry (*Symphoricarpos albus*), by plot, on Site 3, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURN		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	10.83	15.05	9.17	9.96
2	25.00	18.83	12.50	9.65
3	21.67	18.99	8.33	10.30
4	13.33	8.88	15.83	15.05
5	11.67	16.97	16.67	14.97
6	0.00	0.00	13.33	14.35
7	12.50	19.13	0.00	0.00
8	13.33	14.97	3.33	8.88
9	25.00	40.56	0.83	2.89
10	23.33	32.84	4.17	7.93
11	5.00	9.05	5.00	6.74
12	14.17	23.14	21.67	17.49
13	16.67	16.70	25.83	37.53
14	30.83	28.75	20.83	21.09
15	2.50	4.52	24.17	10.84
16	15.00	10.00	0.00	0.00
17	9.17	9.96	11.67	19.46
18	9.17	9.00	5.83	10.84
19	12.50	15.45	25.00	14.46
20	23.33	21.88	24.17	22.34
21	3.33	6.51	7.50	11.38
22	25.00	21.53	3.33	7.79
23	25.00	20.67	18.33	17.49
24	4.17	9.00	21.67	21.25

Table 5. Pretreatment densities (no./1 m2) of common snowberry (*Symphoricarpos albus*), by plot, on Site 4, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURN		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	22.50	17.12	4.17	9.96
2	17.50	20.94	9.17	15.05
3	29.17	15.64	4.17	6.69
4	0.00	0.00	3.33	8.89
5	23.33	32.84	17.50	16.58
6	49.17	25.03	35.00	28.44
7	18.33	20.38	4.17	9.96
8	0.00	0.00	5.83	13.79
9	2.50	6.22	8.33	11.15
10	3.33	6.51	10.83	9.96
11	0.00	0.00	20.83	15.64
12	3.33	7.79	2.50	4.52
13	0.83	2.89	8.33	9.37
14	3.33	11.55	0.00	0.00
15	16.67	16.14	6.67	11.55
16	19.17	27.12	9.17	11.65
17	4.17	5.15	0.00	0.00
18	26.67	20.60	4.17	9.96
19	2.50	6.22	6.67	12.31
20	7.50	12.88	16.67	26.05
21	0.83	2.89	5.00	7.98
22	5.00	14.46	14.17	16.21
23	0.83	2.89	6.67	10.73
24	12.50	14.22	11.67	11.15

Table 6. Average pretreatment densities (no./1 m2) of common chokecherry (*Prunus virginiana*) by site, in Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

	BURN		UNBURNED	
SITE	MEAN	± SD	MEAN	± SD
1	5.27	3.15	3.10	2.51
2	4.62	4.80	1.38	1.29
3	5.50	4.05	5.63	7.05
4	2.10	1.55	2.36	1.66

Table 7. Pretreatment densities (no./1 m^2) of common chokecherry (*Prunus virginianus*), by plot, on Site 1, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURN		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	4.39	2.40	1.03	1.91
2	8.75	5.83	4.10	3.09
3	7.00	3.80	3.70	2.33
4	9.44	4.24	2.15	2.28
5	7.22	7.42	1.80	1.55
6	6.75	2.51	1.65	0.70
7	7.06	2.08	1.30	0.82
8	2.47	2.33	8.20	3.54
9	0.28	0.58	6.55	2.86
10	3.30	3.71	1.25	1.26
11	3.65	5.37	6.55	2.66
12	4.15	4.48	0.44	1.39
13	2.00	2.63	3.85	1.07
14	2.85	3.33	0.28	0.87
15	6.47	4.60	1.80	0.67
16	3.83	2.11	1.05	1.11
17	3.58	2.21	0.85	0.68
18	2.63	2.64	2.10	2.55
19	14.69	7.14	0.36	0.67
20	6.78	3.21	2.90	0.65
21	3.00	3.70	3.65	2.61
22	4.65	4.47	9.20	6.20
23	8.75	9.18	5.05	2.17
24	2.75	2.64	4.60	2.83

Table 8. Pretreatment densities (no./m2) of common chokecherry (*Prunus virginianus*), by plot, on Site 2, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURN		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	6.15	3.18	5.15	2.32
2	4.30	2.32	2.05	1.71
3	5.75	2.54	0.60	0.38
4	7.30	2.37	0.90	1.18
5	5.60	4.93	2.00	2.21
6	2.45	2.01	1.75	1.55
7	6.10	4.17	3.10	2.54
8	4.10	1.52	0.55	0.87
9	0.95	1.19	1.81	2.42
10	0.20	0.11	0.40	2.34
11	0.00	0.00	0.19	0.45
12	8.50	10.98	0.06	0.35
13	0.28	0.42	0.00	0.11
14	0.40	0.42	0.00	0.00
15	2.28	2.85	1.65	0.00
16	5.30	4.57	0.00	0.00
17	0.39	0.75	0.50	0.00
18	22.75	5.75	2.40	0.76
19	2.90	1.96	2.60	1.68
20	3.60	2.32	2.10	1.31
21	7.25	4.99	0.90	0.99
22	0.90	0.63	0.06	0.14
23	3.65	1.81	3.00	0.11
24	9.75	7.21	1.30	1.19

Table 9. Pretreatment densities (no./1 m2) of common chokecherry (*Prunus virginianus*), by plot, on Site 3, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURNED		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	1.42	1.32	4.45	2.82
2	5.75	3.44	3.85	1.08
3	1.00	0.79	3.35	3.29
4	3.45	1.88	2.45	0.74
5	4.70	3.55	4.05	0.54
6	4.05	4.46	4.50	2.97
7	4.95	1.26	2.25	1.91
8	3.90	2.92	3.60	2.65
9	2.50	1.77	4.40	3.04
10	2.90	2.17	1.30	0.76
11	8.45	2.51	0.67	0.61
12	5.20	3.47	3.40	0.66
13	7.80	4.15	0.03	0.14
14	4.45	3.44	3.45	0.08
15	0.00	0.00	1.20	1.26
16	11.65	2.67	1.55	0.84
17	6.95	1.93	1.60	1.04
18	7.30	2.89	21.45	6.02
19	19.20	8.10	5.35	5.52
20	9.55	4.94	5.70	3.23
21	1.65	1.13	11.70	6.34
22	3.65	1.59	10.20	6.74
23	4.45	3.48	9.60	2.86
24	7.00	1.40	5.00	5.79

Table 10. Pretreatment densities (no./1 m2) of common chokecherry (*Prunus virginianus*), by plot, on Site 4, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURN		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	2.25	3.38	2.25	2.51
2	3.35	3.49	3.65	3.49
3	0.25	0.56	0.11	0.14
4	2.30	1.87	0.06	0.13
5	0.25	0.35	3.70	0.11
6	0.85	1.32	0.17	0.33
7	1.75	0.73	4.70	0.28
8	2.11	2.19	0.28	0.65
9	2.30	1.73	2.15	0.51
10	2.65	1.77	0.81	2.39
11	2.65	1.23	2.80	1.85
12	1.95	0.86	1.06	4.11
13	0.50	0.59	2.35	3.07
14	1.35	0.84	1.30	1.39
15	1.20	0.86	1.60	1.96
16	7.65	3.21	6.10	1.64
17	1.70	1.10	0.14	0.36
18	0.65	1.32	2.60	0.28
19	3.60	1.65	3.80	3.84
20	3.85	1.55	2.60	1.76
21	2.15	0.89	3.00	4.36
22	2.40	1.08	3.65	1.13
23	0.75	0.25	3.20	2.18
24	2.05	0.69	4.60	1.85

Table 11. Average pretreatment densities (no./1 m^2) of poison ivy (*Toxicodendron rydbergii*) by site, in Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

	BURN		UNBURNED	
SITE	MEAN	± SD	MEAN	± SD
1	0.46	0.97	0.90	2.09
2	0.01	0.03	0.31	0.99
3	2.66	4.53	7.88	4.12
4	3.06	4.31	1.61	1.80

Table 12. Pretreatment densities (no./1 m^2) of poison ivy (*Toxicodendron rydbergii*), by plot, on Site 1, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURNED		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	0.44	0.44	3.20	3.12
2	1.36	1.36	2.55	3.76
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	1.92	1.92	0.00	0.00
6	1.69	1.69	0.05	0.11
7	4.03	4.03	0.00	0.00
8	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00
10	0.00	0.00	0.90	1.25
11	0.00	0.00	3.15	2.85
12	0.00	0.00	0.00	0.00
13	1.40	1.61	0.00	0.00
14	0.00	0.00	0.00	0.00
15	0.03	0.03	0.00	0.00
16	0.00	0.00	0.15	0.34
17	0.00	0.00	1.25	2.25
18	0.00	0.00	0.85	1.32
19	0.00	0.00	0.00	0.00
20	0.06	0.06	0.00	0.00
21	0.00	0.00	9.50	11.61
22	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00

Table 13. Pretreatment densities (no./m2) of poison ivy (*Toxicodendron rydbergii)*, by plot, on Site 2, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURN		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.15	0.34	0.00	0.00
6	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00
10	0.00	0.00	0.05	0.11
11	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00
15	0.00	0.00	0.35	0.55
16	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00
20	0.00	0.00	2.95	4.73
21	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00
23	0.00	0.00	4.00	3.25
24	0.00	0.00	0.00	0.00

Table 14. Pretreatment densities (no./1 m2) of poison ivy (*Toxicodendron rydbergii*), by plot, on Site 3, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURNED		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	4.25	9.50	12.55	3.10
2	1.45	2.21	16.60	4.85
3	0.00	0.00	13.15	6.77
4	20.80	6.12	9.05	3.35
5	6.85	7.11	13.55	3.51
6	0.10	0.22	13.55	6.27
7	4.75	5.46	8.30	4.01
8	0.65	1.45	5.20	1.84
9	2.25	1.56	6.20	2.24
10	7.10	7.73	4.40	2.58
11	5.75	6.76	2.90	4.28
12	4.45	6.15	7.50	4.52
13	1.10	2.46	0.10	0.22
14	2.15	3.60	5.90	3.89
15	0.00	0.00	1.45	2.08
16	0.00	0.00	5.85	2.77
17	2.20	2.30	7.30	2.72
18	0.00	0.00	5.85	5.40
19	0.00	0.00	10.90	2.30
20	0.00	0.00	11.20	2.30
21	0.00	0.00	9.55	6.08
22	0.00	0.00	5.90	6.91
23	0.00	0.00	4.60	2.49
24	0.00	0.00	7.65	3.04

Table 15. Pretreatment densities (no./m2) of poison ivy (*Toxicodendron rydbergii)*, by plot, on Site 4, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURN		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	3.55	4.27	3.30	1.41
2	6.20	4.54	1.10	1.13
3	4.80	5.28	0.00	0.00
4	9.90	3.94	0.00	0.00
5	0.80	1.41	0.00	0.00
6	4.35	5.66	0.00	0.00
7	1.40	3.13	0.45	0.67
8	19.60	4.55	2.90	5.54
9	6.40	4.36	1.50	0.87
10	1.65	1.13	2.95	3.63
11	1.95	3.83	6.55	2.04
12	2.40	3.31	0.15	0.34
13	0.90	1.63	2.70	2.34
14	0.10	0.22	0.30	0.67
15	1.85	1.84	1.50	1.57
16	0.20	0.21	2.05	0.99
17	0.90	0.98	0.00	0.00
18	0.00	0.00	1.75	1.79
19	0.85	1.90	0.55	0.97
20	3.40	3.46	2.10	1.23
21	1.80	1.54	1.60	2.17
22	0.20	0.45	6.10	3.49
23	0.00	0.00	0.30	0.33
24	0.15	0.34	0.90	0.98

Table 16. Average pretreatment densities (no./1 m^2) of rose (*Rosa spp.*) by site, in Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

	BURN		UNBURNED	
SITE	MEAN	± SD	MEAN	± SD
1	0.10	0.18	0.22	0.53
2	0.00	0.00	0.04	0.15
3	0.48	0.70	0.35	0.42
4	0.14	0.30	0.04	0.08

Table 17. Pretreatment densities (no./m2) of rose (*Rosa spp.*), by plot, on Site 1, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURN		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	0.00	0.00	0.00	0.00
2	0.19	0.19	0.00	0.00
3	0.00	0.00	0.30	0.54
4	0.00	0.00	0.15	0.34
5	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00
7	0.06	0.06	0.00	0.00
8	0.00	0.00	0.00	0.00
9	0.00	0.00	0.55	1.23
10	0.05	0.11	0.55	0.76
11	0.25	0.56	0.00	0.00
12	0.30	0.67	0.00	0.00
13	0.00	0.00	0.00	0.00
14	0.00	0.00	0.05	0.11
15	0.64	0.64	0.10	0.14
16	0.00	0.00	0.00	0.00
17	0.00	0.00	2.55	2.09
18	0.00	0.00	0.50	0.53
19	0.00	0.00	0.00	0.00
20	0.06	0.14	0.00	0.00
21	0.00	0.00	0.25	0.56
22	0.20	0.45	0.00	0.00
23	0.60	0.65	0.35	0.55
24	0.15	0.34	0.00	0.00

Table 18. Pretreatment densities (no./1 m2) of rose (*Rosa spp.*), by plot, on Site 2, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURN		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00
13	0.00	0.00	0.70	1.10
14	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00
20	0.00	0.00	0.20	0.45
21	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00

Table 19. Pretreatment densities (no./m2) of rose (*Rosa spp.*), by plot, on Site 3, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURN		UNBURNED	
PLOT	MEAN	+ SD	MEAN	+ SD
1	2.40	2.66	1.10	1.42
2	2.20	3.01	0.15	0.34
3	0.00	0.00	0.30	0.45
4	0.15	0.34	0.05	0.11
5	0.05	0.11	0.00	0.00
6	0.00	0.00	0.15	0.34
7	0.00	0.00	0.65	0.95
8	0.00	0.00	0.45	0.76
9	0.00	0.00	1.15	1.05
10	0.00	0.00	1.35	0.74
11	0.20	0.45	0.15	0.22
12	1.80	1.54	0.05	0.11
13	0.40	0.65	0.00	0.00
14	0.00	0.00	0.75	0.83
15	0.05	0.11	0.00	0.00
16	0.40	0.58	0.00	0.00
17	0.40	0.38	0.00	0.00
18	0.50	1.12	0.60	0.29
19	0.80	0.33	0.00	0.00
20	0.55	0.48	0.15	0.22
21	0.00	0.00	0.25	0.56
22	0.35	0.49	0.10	0.22
23	1.10	1.18	0.00	0.00
24	0.15	0.22	0.90	0.22

Table 20. Pretreatment densities (no./1 m2) of rose (*Rosa spp.*), by plot, on Site 4, in Fort Meade Recreation Area, Sturgis, South Dakota.

	BURN		UNBURNED	
PLOT	MEAN	± SD	MEAN	± SD
1	0.00	0.00	0.00	0.00
2	0.10	0.14	0.00	0.00
3	0.05	0.11	0.00	0.00
4	0.10	0.22	0.00	0.00
5	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00
7	0.25	0.43	0.00	0.00
8	0.40	0.65	0.00	0.00
9	1.05	0.91	0.05	0.11
10	0.00	0.00	0.10	0.22
11	0.00	0.00	0.10	0.14
12	0.00	0.00	0.05	0.11
13	0.00	0.00	0.15	0.34
14	0.00	0.00	0.00	0.00
15	0.00	0.00	0.10	0.22
16	0.00	0.00	0.00	0.00
17	0.05	0.11	0.00	0.00
18	0.00	0.00	0.00	0.00
19	0.10	0.22	0.00	0.00
20	0.10	0.22	0.00	0.00
21	1.05	1.54	0.00	0.00
22	0.00	0.00	0.35	0.78
23	0.00	0.00	0.00	0.00
24	0.00	0.00	0.05	0.11

Table 21. Average diameter (dbh), number of root sprouts, and ages of bur oak (*Quercus macrocarpa*) trees, by site (for burn treatments), in Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

	DBH (cm)		ROOT SPROUTS		AGE	
SITE	MEAN	± SD	MEAN	± SD	MEAN	± SD
1	14.59	7.97	1.92	3.03	41.25	9.79
2	24.73	10.69	1.65	3.91	80.41	23.85
3	18.09	8.60	0.51	1.32	67.76	18.75
4	17.40	8.90	0.30	0.86	74.47	21.88

Table 22. Average dbh, number of root sprouts, and age of bur oak (*Quercus macrocarpa*) trees on Site 1 (burn treatment) in Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

		DBH (cm)		ROOT SPROUTS		AGE	
PLOT	n	MEAN	± SD	MEAN	± SD	MEAN	± SD
1	2	15.85	3.89	0.00	0.00	43.00	0.00
2	2	8.05	1.34	1.50	2.12	-	-
3	3	8.87	3.40	2.00	0.00	28.00	0.00
4	0	-	-	-	-	-	-
5	3	12.43	4.69	1.33	0.58	39.50	2.12
6	3	18.63	21.11	1.00	0.00	51.00	0.00
7	5	12.60	9.33	0.00	0.00	32.50	0.71
8	1	14.90	0.00	0.00	0.00	42.00	0.00
9	5	17.96	5.95	0.00	0.00	47.50	5.07
10	2	31.00	13.86	0.00	0.00	63.00	24.04
11	3	16.30	1.23	7.50	4.95	45.33	6.03
12	6	15.18	15.65	7.00	0.00	60.50	24.75
13	10	12.94	5.59	1.30	2.87	42.00	4.55
14	6	10.65	4.43	2.50	2.12	37.00	7.81
15	7	12.04	3.09	0.00	0.00	43.40	1.82
16	2	16.00	0.28	8.00	4.24	38.00	5.66
17	1	9.80	0.00	5.00	0.00	-	-
18	1	22.20	0.00	0.00	0.00	35.00	0.00
19	1	19.10	0.00	0.00	0.00	42.00	0.00
20	3	17.93	8.92	0.00	0.00	39.50	3.54
21	4	14.98	7.76	0.00	0.00	35.67	10.50
22	0	-	-	-	-	-	-
23	3	17.00	3.63	0.00	0.00	33.75	1.71
24	7	14.93	4.57	0.00	0.00	34.83	3.49

Table 23. Average dbh, number of root sprouts, and age of bur oak (*Quercus macrocarpa*) trees on Site 2 (burn treatment) in Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

		DBH (cm)		ROOT SPOUTS		AGE	
PLOT	n	MEAN	± SD	MEAN	± SD	MEAN	± SD
1	1	4.40	0.00	0.00	0.00	-	-
2	2	33.05	0.35	8.00	0.00	16.00	0.00
3	6	12.30	6.67	0.00	0.00	56.67	27.02
4	5	21.92	7.90	0.00	0.00	58.60	19.96
5	1	8.50	0.00	3.00	0.00	-	-
6	1	35.70	0.00	1.00	0.00	89.00	0.00
7	7	26.00	11.20	4.00	0.00	85.00	0.00
8	5	24.48	10.52	0.20	0.45	85.67	10.41
9	1	38.50	0.00	5.00	0.00	92.00	0.00
10	1	24.80	0.00	5.00	0.00	90.00	0.00
11	2	34.00	4.67	0.00	0.00	81.00	0.00
12	1	40.40	0.00	0.00	0.00	99.00	0.00
13	4	31.17	11.15	3.75	6.24	94.00	9.90
14	2	33.45	3.89	16.00	2.83	73.00	0.00
15	2	17.90	20.36	0.00	0.00	97.50	12.02
16	2	33.95	1.20	0.00	0.00	113.50	23.33
17	1	37.30	0.00	0.00	0.00	68.00	0.00
18	2	20.95	20.43	0.00	0.00	113.00	0.00
19	3	25.93	9.63	0.00	0.00	82.67	23.18
20	2	31.20	5.80	0.00	0.00	68.00	0.00
21	7	21.45	6.67	1.86	4.10	78.50	28.44
22	2	28.75	9.12	2.00	2.83	98.50	4.95
23	5	27.02	9.95	0.00	0.00	82.00	11.53
24	3	16.70	6.18	0.00	0.00	74.00	0.00

Table 24. Average dbh, number of root sprouts, and age of bur oak (*Quercus macrocarpa*) trees on Site 3 (burn treatment) in Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

		DBH (cm)		ROOT SPROUTS		AGE	
PLOT	n	MEAN	± SD	MEAN	± SD	MEAN	± SD
1	1	12.3	0.00	0.00	0.00	44.00	0.00
2	4	19.38	5.12	0.50	1.00	54.00	7.07
3	4	24.62	11.38	2.00	4.00	85.00	31.19
4	3	22.23	6.97	0.00	0.00	69.33	4.04
5	1	17.25	3.18	0.00	0.00	72.00	0.00
6	1	14.40	0.00	0.00	0.00	101.00	0.00
7	4	19.70	10.80	0.00	0.00	75.33	5.13
8	6	21.28	7.71	0.50	0.84	79.75	5.91
9	9	17.54	6.62	1.44	2.13	65.33	17.42
10	4	23.43	5.64	0.50	1.00	65.67	1.53
11	2	29.15	5.87	0.50	0.71	72.00	0.00
12	10	18.65	8.85	0.20	0.42	71.75	15.00
13	5	13.18	8.06	1.00	1.73	62.50	14.85
14	1	18.50	0.00	0.00	0.00	42.00	0.00
15	4	12.58	3.95	0.00	0.00	38.00	5.29
16	3	17.83	13.16	0.50	0.71	36.00	0.00
17	12	15.74	7.81	1.17	1.60	64.00	24.25
18	7	16.56	10.95	0.00	0.00	81.00	0.00
19	4	7.45	3.62	0.00	0.00	44.00	0.00
20	5	12.34	6.52	0.00	0.00	56.00	0.00
21	9	17.49	6.28	0.40	0.89	76.00	4.24
22	5	27.40	12.65	0.00	0.00	81.33	12.42
23	3	15.13	8.92	0.00	0.00	49.00	11.32
24	3	25.60	6.08	0.00	0.00	97.00	9.90

Table 25. Average dbh, number of root sprouts, and age of bur oak (*Quercus macrocarpa*) trees on Site 4 (burn treatment) in Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

		DBH (cm)		ROOT SPROUTS		AGE	
PLOT	n	MEAN	± SD	MEAN	± SD	MEAN	± SD
1	7	20.40	8.57	1.00	2.00	70.25	10.15
2	6	10.82	7.75	2.00	0.00	66.00	21.21
3	4	19.30	10.03	0.00	0.00	70.00	22.54
4	10	11.72	12.56	1.50	2.12	57.67	24.19
5	1	13.20	0.00	0.00	0.00	44.00	0.00
6	3	27.37	18.82	0.00	0.00	67.00	0.00
7	5	17.52	10.02	1.75	1.71	58.00	19.29
8	3	24.40	5.11	0.00	0.00	75.00	29.61
9	3	29.10	1.95	0.67	1.15	84.00	1.41
10	3	11.67	4.18	0.00	0.00	76.00	41.01
11	8	10.30	6.97	0.20	0.45	75.00	33.94
12	8	14.94	8.24	0.00	0.00	76.33	25.66
13	7	18.86	7.88	0.00	0.00	81.00	0.00
14	8	19.58	11.09	0.00	0.00	87.25	5.68
15	2	12.05	5.02	0.00	0.00	65.00	0.00
16	6	17.98	4.78	0.00	0.00	81.50	3.54
17	4	16.85	11.53	0.25	0.50	66.00	9.90
18	4	16.33	3.84	0.00	0.00	95.00	8.48
19	6	12.05	5.52	0.00	0.00	40.67	28.50
20	10	16.34	5.28	0.00	0.00	72.00	28.88
21	8	20.08	4.68	0.00	0.00	92.80	17.23
22	3	28.73	1.04	0.00	0.00	87.00	0.00
23	8	20.88	6.36	0.00	0.00	92.67	9.61
24	4	23.53	10.11	0.00	0.00	82.00	18.99

Table 26. Average grass and forb aboveground standing crop and litter biomass (kg/ha), by site (for burn treatments), in Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

	FORB		GRASS		LITTER	
SITE	MEAN	± SD	MEAN	± SD	MEAN	± SD
1	103.13	360.30	789.17	648.80	5218.33	4119.81
2	110.05	283.93	375.83	488.08	7764.58	7291.48
3	123.75	225.74	524.33	509.55	8797.71	5806.93
4	100.12	237.85	231.77	302.82	9594.69	8282.03

Table 27. Average forb and grass aboveground standing crop and litter biomass (kg/ha), by plot, on Site 1 (burn treatment), Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

PLOT	FORB	GRASS	SUB-TOTAL	LITTER
1	21.25	622.50	643.75	5877.50
2	10.00	822.50	832.50	7592.50
3	11.25	337.50	348.75	5845.00
4	503.75	762.50	1266.25	5560.00
5	18.75	1115.00	1133.75	3175.00
6	62.50	218.75	281.25	11482.50
7	13.75	402.50	416.25	9727.50
8	43.75	476.25	520.00	4975.00
9	1.25	2175.50	2176.75	5520.00
10	1.25	468.75	470.00	332.50
11	30.00	625.00	655.00	7815.00
12	11.25	293.75	305.00	7712.50
13	121.25	601.25	722.50	5537.50
14	8.75	615.00	623.75	6737.50
15	33.75	860.00	893.75	1650.00
16	170.00	752.50	922.50	3087.50
17	173.75	281.25	455.00	1515.00
18	470.00	796.25	1266.25	3545.00
19	603.75	507.50	1111.25	4482.50
20	77.50	1205.00	1282.50	3387.50
21	8.75	1012.50	1021.25	2955.00
22	15.00	1701.25	1716.25	3010.00
23	26.25	1161.25	1187.50	8810.00
24	37.50	1143.75	1181.25	1907.50

Table 28. Average forb and grass aboveground standing crop and litter biomass (kg/ha), by plot, on Site 2 (burn treatment), Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

PLOT	FORB	GRASS	SUB-TOTAL	LITTER
1	13.75	10.00	23.75	2202.50
2	86.25	307.50	393.75	5465.00
3	250.00	133.75	383.75	5675.00
4	228.75	6.25	235.00	13217.50
5	156.25	30.00	186.25	11747.50
6	95.00	20.00	115.00	8592.50
7	7.50	10.00	17.50	14027.50
8	50.00	75.00	125.00	7300.00
9	3.75	36.25	40.00	10800.00
10	263.75	367.50	631.25	4875.00
11	1.25	1351.25	1352.50	3312.50
12	12.50	853.75	866.25	8287.50
13	40.00	641.25	681.25	7202.50
14	21.25	536.25	557.50	4320.00
15	3.75	693.75	697.50	2712.50
16	42.50	766.25	808.75	14077.50
17	41.25	427.50	468.75	4192.50
18	36.25	571.25	607.50	9137.50
19	163.75	797.50	961.25	5417.50
20	320.00	285.00	605.00	9225.00
21	581.25	75.00	656.25	12520.00
22	47.50	447.50	495.00	9867.50
23	120.00	212.50	332.50	7462.50
24	55.00	365.00	420.00	4712.50

Table 29. Average forb and grass aboveground standing crop and litter biomass (kg/ha), by plot, on Site 3 (burn treatment), Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

PLOT	FORB	GRASS	SUB-TOTAL	LITTER
1	611.25	942.50	1553.75	5172.5
2	300.00	483.75	783.75	6565.0
3	106.25	550.00	656.25	7535.0
4	235.00	125.00	360.00	11160.0
5	156.25	390.00	546.25	9165.0
6	36.25	746.25	782.50	1134.0
7	58.75	422.50	481.25	12580.0
8	121.25	1122.50	1243.75	6797.5
9	57.50	1025.00	1082.50	8392.5
10	76.25	651.25	727.50	10480.0
11	25.00	445.00	470.00	9067.5
12	18.75	870.00	888.75	6282.5
13	87.50	293.75	381.25	8627.5
14	356.25	760.00	1116.25	3895.0
15	22.50	402.50	425.00	5982.5
16	83.75	287.50	371.25	6965.0
17	75.00	213.75	288.75	14947.5
18	31.25	71.25	102.50	14677.5
19	38.75	372.50	411.25	7522.5
20	263.75	296.25	560.00	7237.5
21	27.50	760.00	787.50	6130.0
22	117.50	525.00	642.50	7740.0
23	3.75	748.75	752.50	4232.5
24	0.00	78.75	78.75	18650.0

Table 30. Average forb and grass aboveground standing crop and litter biomass (kg/ha), by plot, on Site 4 (burn treatment), Fort Meade Recreation Area, Sturgis, South Dakota, 1986.

PLOT	FORB	GRASS	SUB-TOTAL	LITTER
1	60.00	240.00	300.00	10675.00
2	126.25	405.00	531.25	8017.50
3	41.25	450.00	491.25	8625.00
4	177.50	155.00	332.50	5642.5
5	416.00	615.00	1031.00	1752.50
6	103.75	433.75	537.50	15930.00
7	82.50	211.25	293.75	8645.00
8	198.75	463.75	662.50	6387.50
9	12.50	293.75	306.25	9387.50
10	117.50	162.50	280.00	930.00
11	11.25	37.50	48.75	9850.00
12	20.00	21.25	41.25	4477.50
13	3.75	2.50	6.25	14847.50
14	11.25	2.50	13.75	8187.50
15	18.75	552.50	571.25	8452.50
16	53.75	5.00	58.75	17137.50
17	60.00	61.25	121.25	10696.00
18	123.75	335.00	458.75	7757.50
19	95.00	223.75	318.75	11070.00
20	218.75	178.75	397.50	14382.00
21	40.00	13.75	53.75	3105.00
22	160.00	641.25	801.25	5857.50
23	42.50	3.75	46.25	23405.00
24	215.00	53.75	268.75	15055.00